



The Effects of TID on Wear-Out of Advanced Flash Memories

**D.N. Nguyen, L.Z. Scheick, G.M. Swift, S.M. Guertin
and A. H. Johnston**

**Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California**

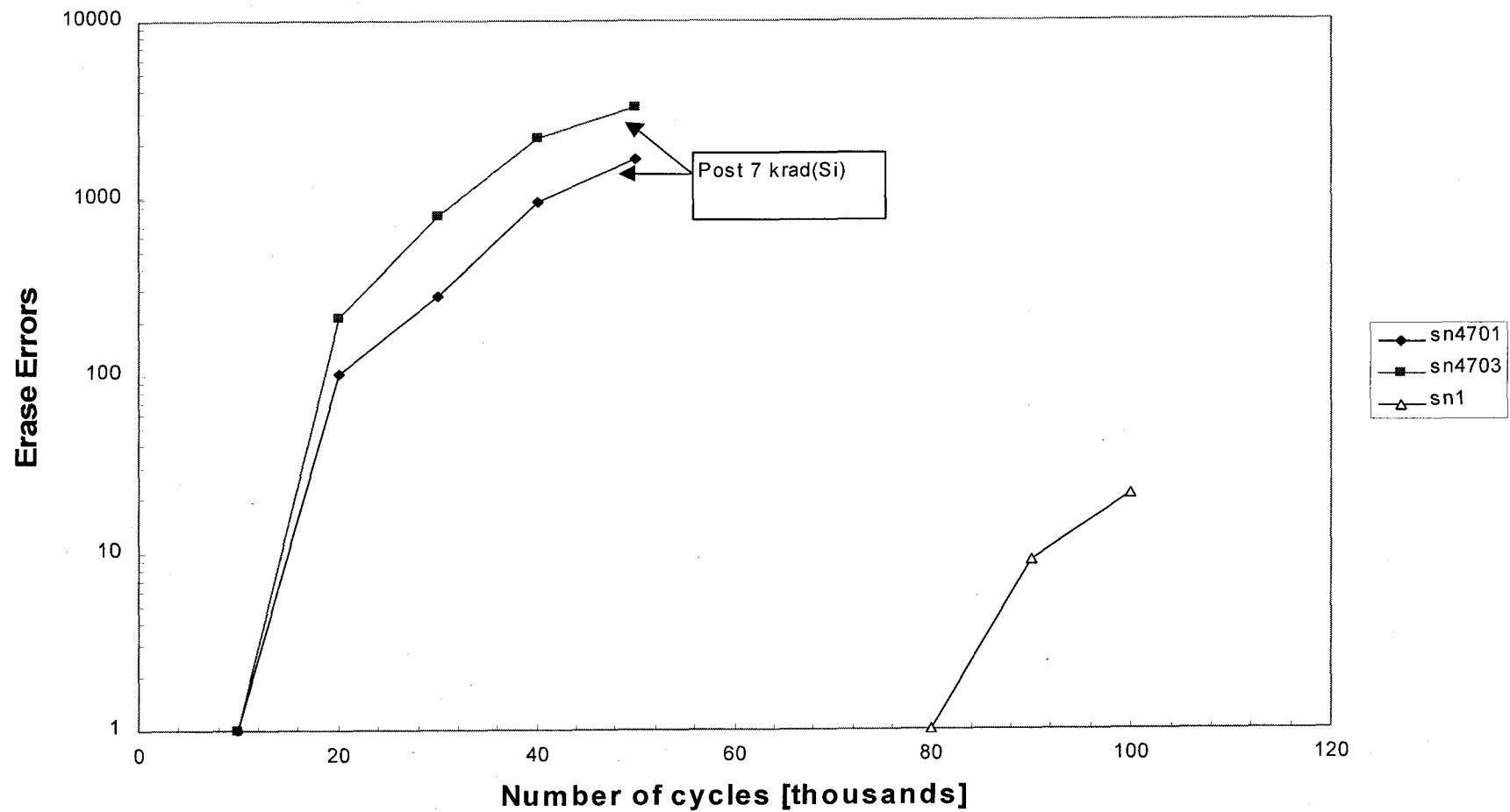
The research in this paper was carried out by the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.



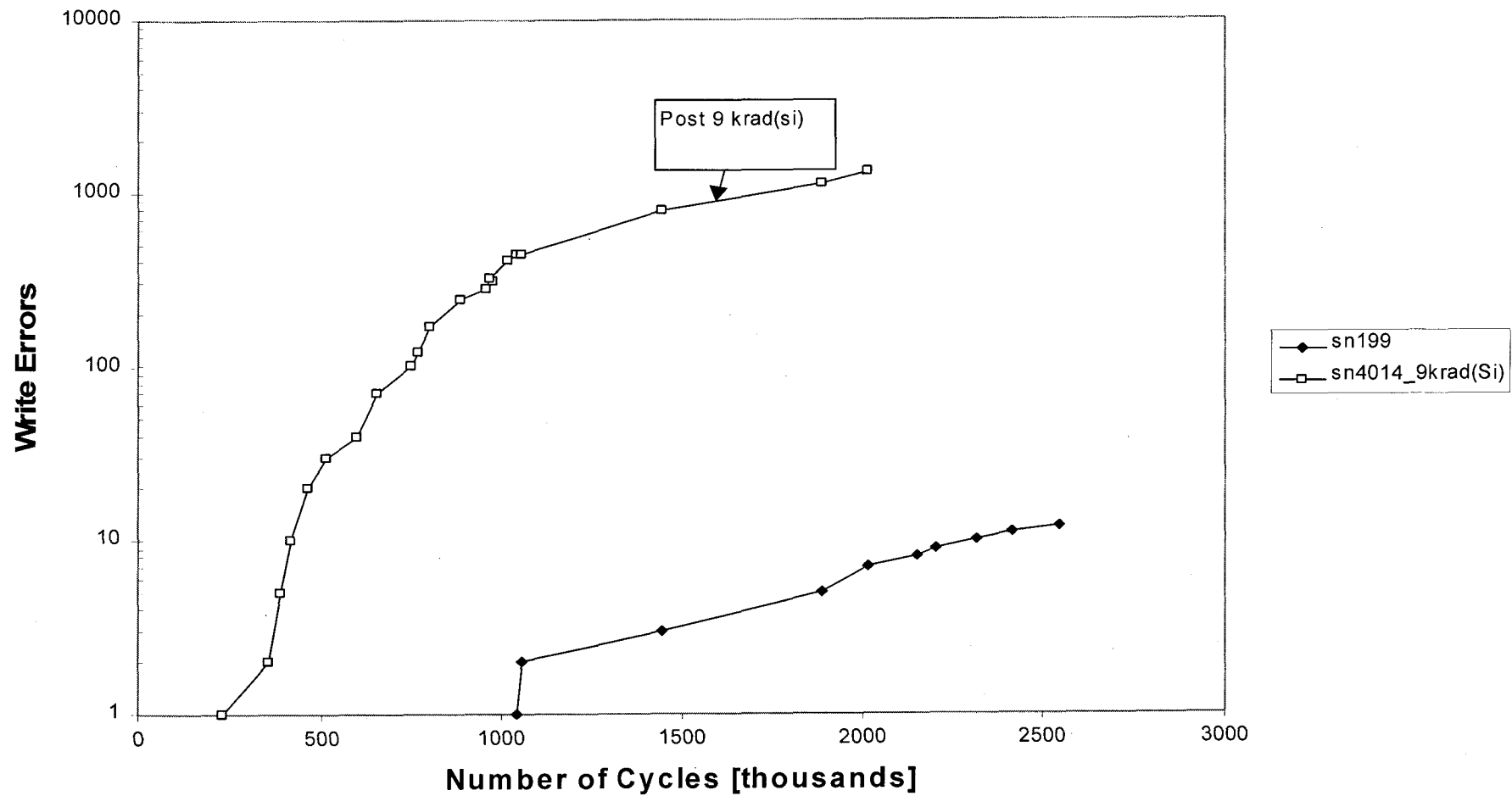
- Introduction
- TID Effects on Wear-Out of Erase/Write Capability
- Dependence of Wear-Out on Charge Pump Degradation
- Correlation of Charge Pump Degradation with Erase Failure
- Mechanism of Wear-Out
- Summary

- **Applications**
 - ◆ Commercial: digital camera, wireless communications, storage
 - ◆ Space: solid-state recorder
- **Flash memory technologies descriptions: NAND and NOR**
- **Internal charge pump: eliminate second power supply needed for erase and programming function**
- **Degradation of charge pump under TID effects**

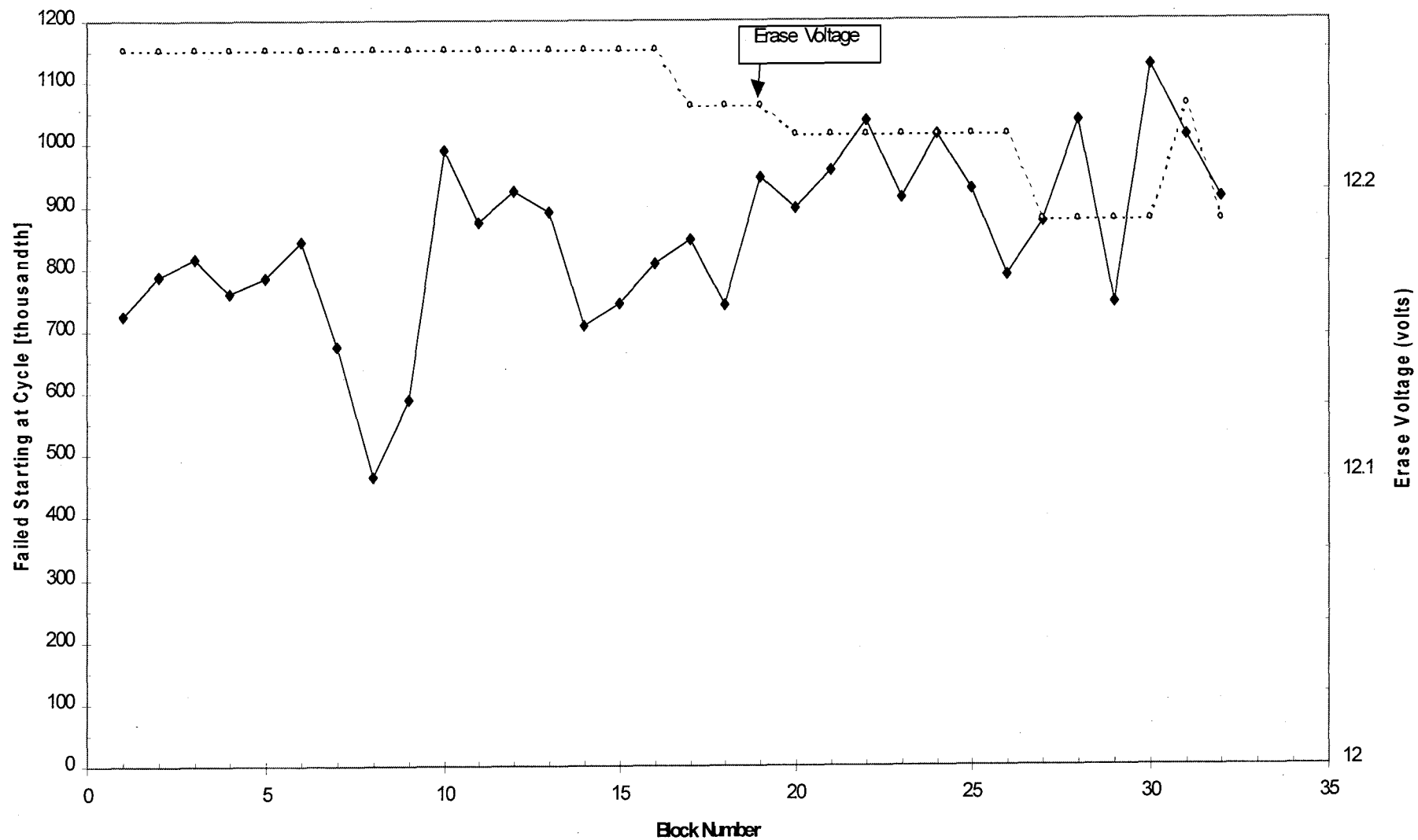
Wear-Out of Intel Strata Flash Memories



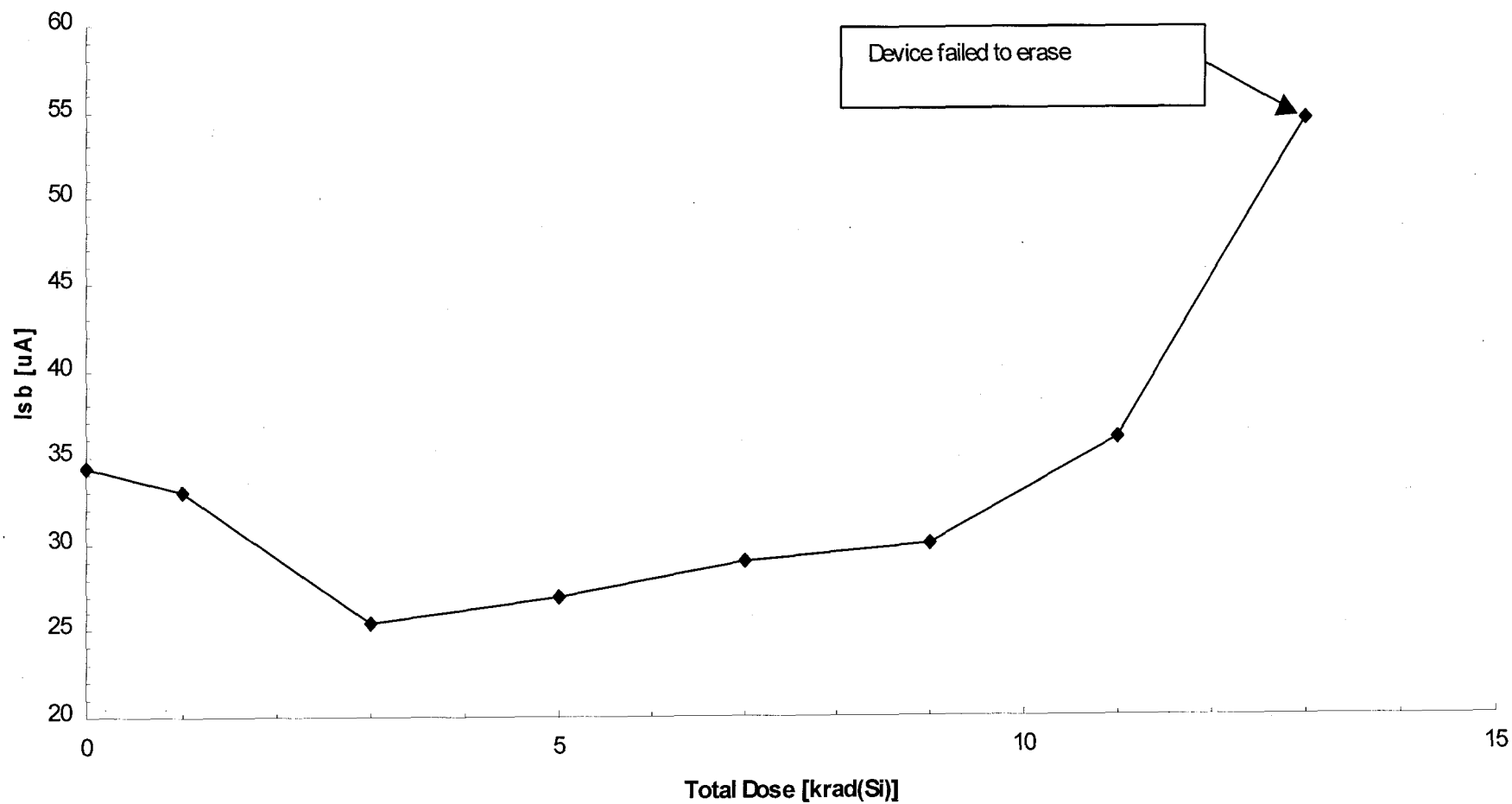
Wear-out of irradiated and non-exposed Samsung flash memory device



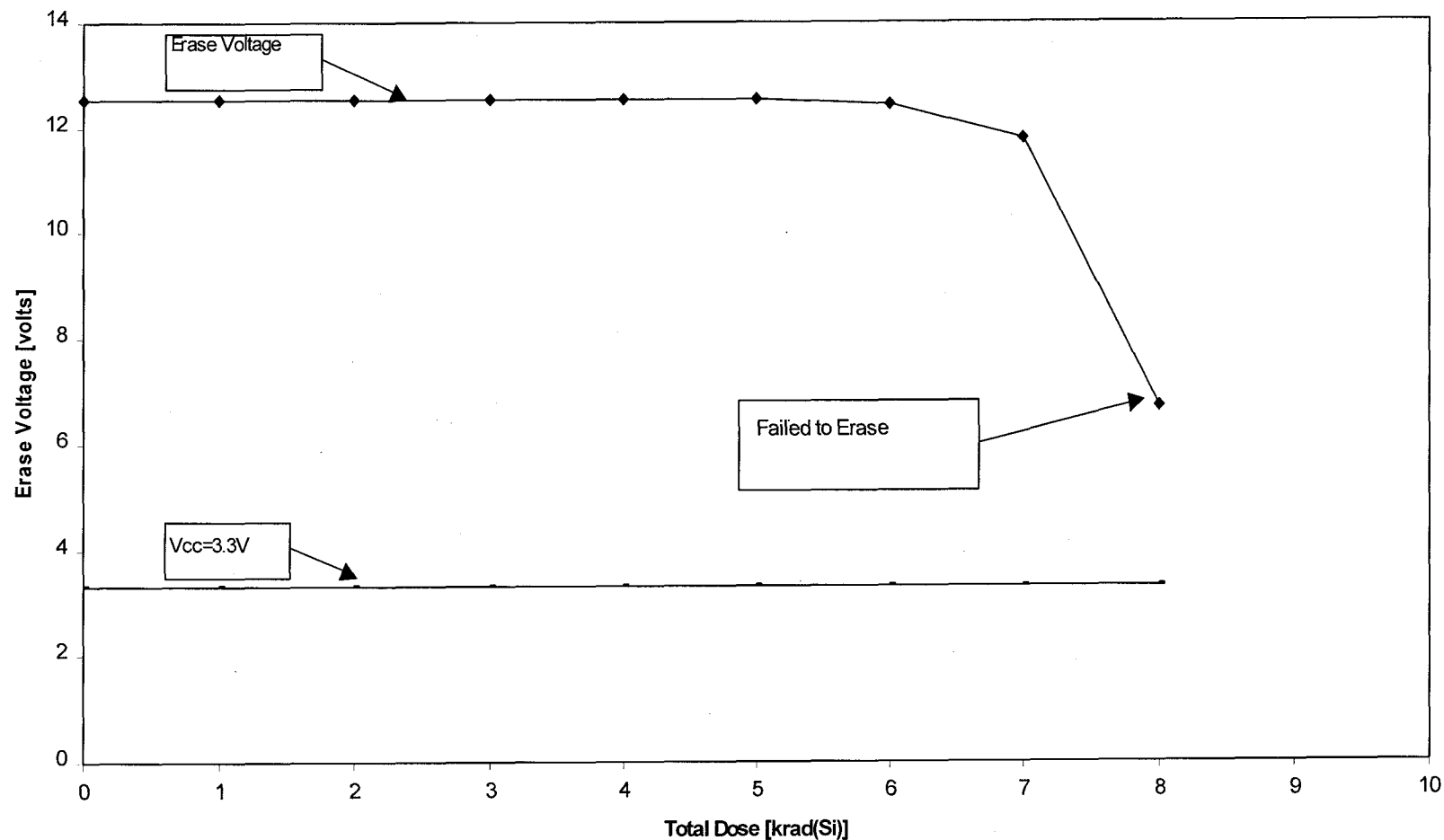
Wear-Out Distribution (Erase) Chart of Samsung KM29T128



Isb vs Total Dose
Intel Strata 28F128



Erase Voltage vs Total Dose (ref. To ground pad)
Samsung KM29U128T



- **Issues:**
 - ◆ Internal Charge Pump Degradation
 - ◆ Wear-Out
- **Radiation Harden the peripheral circuitry, including charge pump**
- **Prevent charge pump degradation from TID with well shield scheme**
- **Scale to lower erase/write voltage**